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Health Technical Memorandum 2040

Management policy

The control of legionellae in healthcare premises – a code of practice

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Health Departments

NHS Estates
An Executive Agency of the Department of Health

Health Technical Memorandum 2040

Management policy

The control of legionellae in healthcare premises – a code of practice

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An Executive Agency of the Department of Health

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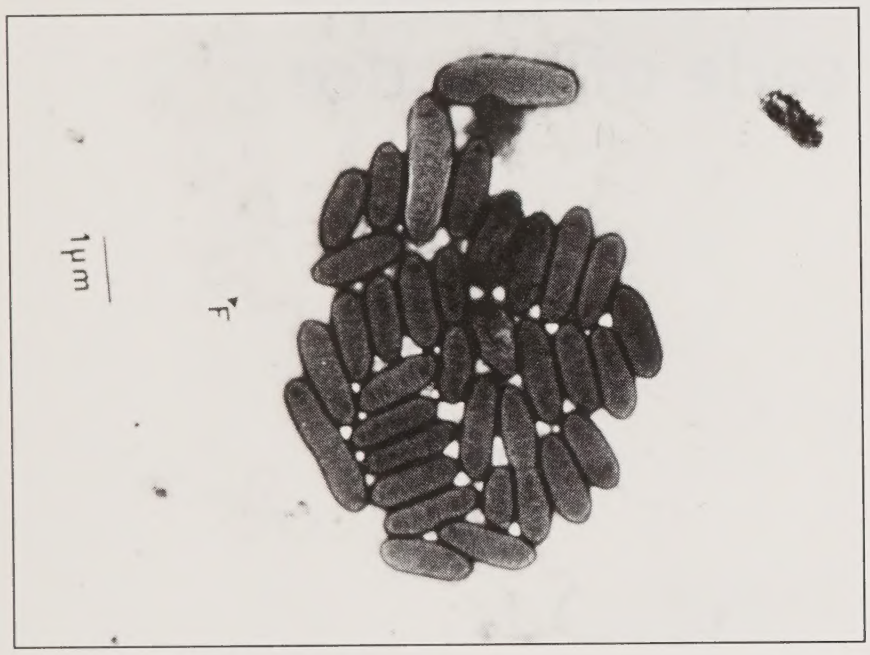
Scanning electron micrograph of a biofilm on latex showing amoeba grazing the bacterial consortium (magnification x 1440). Reproduced by kind permission of Julie Rogers and A B Dowsett, Public Health Laboratory Service Centre for Applied Microbiology and Research, Porton Down, Salisbury, Wiltshire.



Above:
A colony of bacteria *Legionella pneumophila*. The bacteria are non-sporing, typically 2–3 μm long, 0.3–0.9 μm wide. Flagella, which can be clearly seen, provide mobility of the organism. Reproduced by kind permission of Public Health Laboratory Service Centre for Applied Microbiology and Research.

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About this publication

Health Technical Memorandum (HTM) 2040 provides recommendations, advice and guidance on controlling legionellae in healthcare premises. It is applicable to new and existing sites, and is for use at various stages during the inception, design, upgrading, refurbishment, extension and maintenance of a building.

HTM 2040 focuses on the:

a. legal and mandatory requirements;

b. design of systems;

c. maintenance of systems;

d. operation of systems.

It is published as five separate volumes, each addressing a specialist discipline:

a. this volume – **Management policy** – outlines the overall responsibility of managers of healthcare premises, and details their legal and mandatory obligations. It summarises the essential background information required to understand the principles of the control of legionellae. This is followed by an epidemiology of legionellosis, essential to understanding the rationale behind the various control and design measures advocated in succeeding volumes. A management checklist is provided in the Appendix to this volume; it lists the major tasks and should form the basis of a risk assessment;

b. **Design considerations** – highlights the overall requirements and considerations that should be applied to the design up to the contract document;

c. **Validation and verification** – considers the testing and commissioning aspects, also providing guidance on the identification of problem areas;

d. **Operational management** – considers aspects of preventing and controlling legionellae. It also contains information on the operation, maintenance and cleaning of evaporative cooling towers;

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e. **Good practice guide** – gives advice on the course of action if an outbreak of legionnaires' disease is suspected, on the cleaning and disinfection of a cooling tower implicated in an outbreak of legionnaires' disease, and on the use of sodium hypochlorite solutions for chlorination of cooling water systems in hospitals. Further advice is given in the form of:

(i) emptying times for cooling tower ponds;

(ii) a questionnaire to assess the serviceability of existing cooling systems;

(iii) a sample logbook for the planned maintenance of a cooling tower.

Guidance in this Health Technical Memorandum is complemented by the library of National Health Service Model Engineering Specifications. Users of the guidance are advised to refer to the relevant specifications.

The contents of this Health Technical Memorandum in terms of management policy, operational policy and technical guidance are endorsed by:

a. the Welsh Office for the NHS in Wales;

b. the Health and Personal Social Services Management Executive in Northern Ireland;

c. the National Health Service in Scotland Management Executive;

and they set standards consistent with Departmental Cost Allowances.

This HTM was written with the advice and assistance of experts in the NHS and industry.

References to legislation appearing in the main text of this guidance apply in England and Wales. Where references differ for Scotland and/or Northern Ireland these are given in marginal notes.

Where appropriate, marginal notes are also used to amplify the text.

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1.0 Introduction

General

1.1 The guidance contained in this volume is applicable to new and existing sites, and is for use at various stages during the inception, design, upgrading, refurbishment, extension and maintenance of a building.

1.2 The approach should be to remove all potential sources of seeding, growth and spread of legionellae. Where this ideal cannot be achieved in existing situations, steps should be taken to control and prevent legionellae by sound operational management.

1.3 The control of legionellae is a continuing responsibility. The effectiveness of precautionary measures should be continually monitored, and a continuing programme to ensure awareness should be devised. Although knowledge of legionellosis has improved markedly in recent years there is a continuing misunderstanding about the method of dissemination. Many people are under the impression that cooling towers are the only source of legionellae in building service systems. All water systems are capable of colonisation by legionellae, and taps are just as capable of generating an aerosol as showers or, indeed, cooling towers.

1.4 The biggest risk is complacency leading to the deterioration of water hygiene to the extent that an outbreak of the disease occurs.

1.5 The general manager/chief executive has the responsibility of ensuring that designated staff are appointed.

1.6 This HTM does not include advice on water supplies for clinical equipment such as dialysers, nebulisers and respiratory humidifiers or for water services for pharmacy and dental departments. Users of clinical humidifiers and nebulisers are reminded that sterile water, not tap water, should be used and that they should be emptied and cleaned thoroughly following each period of use. All equipment with water reservoirs should be stored dry. Water for any other purpose should meet any identifiable local requirements, but users must recognise that any water system may provide a suitable environment for legionellae and other water-borne organisms.

Scotland: SHHD/DS(80)26

1.7 HTM 27 – 'Cold water supply storage and mains distribution' should be consulted for guidance on the general design and operation of water systems in healthcare premises.

Application to premises

1.8 Precautions to prevent outbreaks of legionnaires' disease are required even in those premises which to date have not been infected. The guidance should be used for all sites where there is in-patient or out-patient accommodation, for example hospitals, clinics, health centres and Blood Transfusion Service premises.

Northern Ireland: Personal Social Services and healthcare is a combined service in Northern Ireland; this guidance should be used for all social services facilities where there is residential or day care accommodation

Northern Ireland: Nursing Homes and Nursing Agencies Act(Northern Ireland) 1971; the Nursing Agencies (Northern Ireland) Order 1985 SI 1985/1775

1.9 If it can be positively determined that offices, staff residences, workshops, laundries or ambulance stations have discrete water systems, that is, self-contained systems which do not serve patient areas, HSE Guidance Note HS(G)70 may be used. In practice, however, it is likely to be the same group or team of managers and craftsmen which is accountable for the whole premises. Consequently, it may be considered preferable to work to a single document, that is, HTM 2040, to ensure that confusion does not prejudice the quality of maintenance work.

Northern Ireland: Health and Safety Agency for Northern Ireland publication HSA 62

Priorities

1.10 Premises designed since 1988 should be in compliance with NHS Estates 'The Control of Legionellae in Health Care Premises – A Code of Practice', HMSO (1988).

Scotland: SHHD/DGMs (1988)50; (1989)35; 1989(77); 1990(51) and 1991(15)

Northern Ireland: CEC-88-3-CEI and HSS (ESD) 6/90

1.11 All existing premises should be regularly reviewed to identify where they do not meet the advice in this HTM. A realistic programme should be prepared to eradicate any shortfall. Priority should be given to patient areas, although the exact priority will depend on local circumstances.

2.0 Statutory obligations

Health and Safety at Work

Northern Ireland: the Health and Safety at Work Act Order(NI) 1978

2.1 Employers have a general duty, under the Health and Safety at Work etc Act 1974, so far as is reasonably practicable to ensure the health, safety and welfare of their patients, employees and visitors. These duties are legally enforceable, and the Health and Safety Executive have successfully prosecuted occupiers of premises under this statute for outbreaks of legionnaires' disease. It falls upon both owners and occupiers of premises to ensure that there is a management regimen for the proper design, installation and maintenance of plant, equipment and systems. Failure to have a proper system of work and adequate control measures can also be an offence even though an outbreak has not occurred.

Control of Substances Hazardous to Health (COSHH) Regulations

Northern Ireland: Control of Substances Hazardous to Health Regulations (Northern Ireland) 1990

2.2 Also relevant are the Control of Substances Hazardous to Health (COSHH) Regulations 1988 which came into force on 1 October 1989. These regulations apply to micro-organisms, including legionellae, which could create a health hazard. These regulations also apply to the chemicals which may be used to control the growth of organisms in water supply.

Public Health (Infectious Diseases) Regulations

HC(88)64 and EL(91)123 contain further advice and guidance on communication and cooperation with the CCDC, and on arrangements for support of the CCDC and for him to have access to provider units, including NHS trusts

Scotland HSS(CH)1/89

Northern Ireland: Legionellosis is a notifiable disease, Public Health Notifiable Diseases Order (Northern Ireland) 1990 ST1990/66

Scotland: Legionellosis is a notifiable disease

2.3 The Public Health (Infectious Diseases) Regulations 1988 require that a proper officer (now usually the consultant in communicable disease control (CCDC)) shall inform the chief medical officer of any serious outbreak of any disease which to his knowledge has occurred in his district.

Water Supply Regulations

2.4 The Water Supply (Water Quality) Regulations 1989, Water supply (Water Quality) (Amendment) Regulations 1991. These regulations apply to water stored and distributed within any hospital which is used for drinking and any domestic purpose.

2.5 The Private Water Supplies Regulations 1991 (Statutory Instrument no 2790) cover private water supplies (Boreholes and Wells).

Food Act

2.6 The Food Act 1990 covers for water used for food preparation or food manufacture, and also includes water used for drinking.

Approved Code of Practice

2.7 The Health and Safety Commission have published an 'Approved Code of Practice' (ACOP) and the Health and Safety Executive have produced a guidance note (HS(G)70) entitled 'The Control of Legionellosis including Legionnaires' Disease'. The onus is on management to demonstrate that procedures in place are as good as, or better than, those required by the ACOP.

Northern Ireland: The equivalent ACOP 'Prevention or Control of Legionellosis including Legionnaires' Disease' published by the Health and Safety Agency for Northern Ireland – HSA 62 – is in preparation

Scotland: The Public Health (Notification of Infectious Diseases) (Scotland) Regulations 1975 and 1988 with amendments

2.8 Compliance with the guidance given in this HTM will satisfy the ACOP requirements.

2.9 The health service, with responsibility for the wider aspects of public health and the operation of NHS premises, is expected to be particularly vigilant. The courts will expect a higher standard of care from public bodies, given the resources available to them and the greater risks to the occupants of these premises. Though the number of outbreaks of legionnaires' disease is relatively small, outbreaks are considered to be avoidable. Management must also acknowledge that incidents or outbreaks cause widespread concern especially if associated with healthcare premises. Investigation of these outbreaks has shown that they are generally related to a breakdown in management systems. Design flaws and defects have also been implicated as the cause of some outbreaks.

2.10 Hence, managers need to satisfy themselves, by monitoring, that the procedures are being implemented. It is not sufficient merely to devise procedures.

2.11 It is a widely held misconception that wet cooling towers are the only source of the disease, and that a building without such a tower presents no risk. All water systems are liable to colonisation by legionellae.

2.12 The prohibition of wet cooling towers is not envisaged; in some instances, they provide the only practicable solution. The relevant statutory requirement is to assess risk and the measurements to prevent (or where it is not reasonably practicable to prevent, to minimise) the risk from exposure to legionella.

2.13 The Notification of Cooling Towers and Evaporative Condensers Regulations 1992 (SI 1992/2225) requires the registration of cooling towers and evaporative condensers to the local authority.

Scotland: Directors of environmental health are required to maintain a register of cooling towers and whirlpool spas in association with the Health and Safety Executive

Northern Ireland: Equivalent provisions are proposed for Northern Ireland (Oct 93)

3.0 Management responsibility

Management accountability

3.1 The chief executive or general manager has overall responsibility for all aspects of the quality of water supplies within his/her organisation.

3.2 The procedures instituted should be such as to demonstrate that any person on whom the statutory duty falls has fully appreciated the actual and potential risks of legionellae. Though compliance with this guidance may be delegated to staff, or undertaken by contract, accountability cannot be delegated.

3.3 Regular assessments should be made at least annually, using this guidance, to establish the extent of the risk. Shortfalls should be clearly recorded and the proposed control measures, with timescales, developed. A review should be undertaken whenever there is a substantial change in physical or environmental conditions.

3.4 The objective must be to institute management procedures to ensure that compliance is continuing and not notional. The prime purpose of the assessment is to be able to demonstrate that management has identified all the relevant factors, has instituted corrective or preventive action, and is monitoring that the plans are being implemented.

3.5 This guidance should be applied to all healthcare premises, however small, where there is a duty of care under the Health and Safety at Work etc Act 1974. Smaller premises, such as clinics, present a risk in the same way as a major hospital. Intermittently used areas, for example premises not used over the weekend, may present ideal environments for the growth of legionellae.

Role of infection control team

Generally there will be an individual covering infection control matters

3.6 The infection control team (legionella) should be nominated in writing by the chief executive or general manager for advising on and monitoring infection control policy for legionnaires' disease. The infection control team (legionella) should be involved in the production of the policy and management procedures for the control of legionellae. Similarly, the team has a key role in formulating the plans for its implementation.

3.7 Additionally, the policy should be acceptable to the control of infection team and any amendment to that policy must be agreed by the team.

Nominated person

Training courses on minimising the risk of legionellae in water systems are available from Eastwood Park NHS Training Centre

3.8 A nominated person (legionella), possessing adequate professional knowledge and with appropriate training, should be nominated in writing by the general manager or chief executive to devise and manage the necessary procedures for the prevention of legionnaires' disease. The person will be required to liaise closely with other professionals in various disciplines. In addition, the person should possess a thorough knowledge of the control of legionellae and would ideally be a Chartered Engineer.

3.9 This person's role, in association with the infection control team and maintenance staff, involves:

a. advising on the potential areas of risk and identifying where systems do not comply with this guidance;

b. advising on the necessary continuing procedures for the prevention of legionellae;

c. monitoring the implementation and efficacy of those procedures;

d. approving and identifying any changes to those procedures;

e. maintaining adequate records.

3.10 Implementation of an effective maintenance policy must incorporate the creation of fully detailed operating and maintenance documentation and the introduction of a logbook system. The "nominated person" should appoint a deputy to whom delegated responsibilities may be given. The deputy should act for the nominated person on all occasions when the nominated person is unavailable.

3.11 The nominated person should be fully conversant with the design principles and requirements of water systems and should be fully briefed in respect of the causes and effects of contamination with legionella. The appointment of an engineer as the nominated person is appropriate in that the responsibility can extend to the operation and maintenance of associated plant. It is recognised that the nominated person cannot be a specialist on all matters and must be supported by specialists in specific subjects such as water treatment and microbiology, but he/she must undertake responsibility for calling upon and co-ordinating the activities of such specialists.

Hazard assessment

3.12 Legionellae, which cause legionellosis, are naturally widespread in water systems. It is exceptional for a water supply, either public or private, to be entirely free from aquatic organisms, and for this reason it is important that appropriate measures are taken to guard against conditions which may encourage microbial multiplication. Provided water is derived from the public mains and its quality is preserved in the storage and distribution system by correct design, installation and maintenance, it can be regarded as being microbiologically acceptable for use without further treatment. Strict adherence to the guidance in this HTM will not eradicate legionellae, but there will be reduction in the risk of an outbreak.

3.13 The number of organisms which cause infection has not been reliably determined and is likely to vary from person to person. However, all patients are at risk, and those who are immuno-compromised can be particularly susceptible.

3.14 Particularly susceptible patients will be those found in departments concerned with:

a. head/neck cancer;

b. bone marrow transplant;

c. renal dialysis;

d. leukaemia;

e. organ transplant;

f. AIDS.

3.15 Outbreaks have been linked to the inhalation of infected aerosols. Most people recognise that showers and wet cooling towers generate aerosols. Less well known is that a "fog" of aerosols is generated when a bath or basin is filled. Aerosols can be generated from any water outlet, and no water outlet can be considered free from potential risk. Hence baths, spa baths and hydrotherapy pools also represent hazards. If the water is contaminated, the possibility of the organism being entrained in the aerosol increases.

3.16 These aerosols are buoyant and can remain suspended in the air for a relatively long time. Any air movement will distribute them over quite large distances. Recently it has been shown that the organism can survive even after the "wet" layer of the aerosol has dried.

3.17 For certain immuno-compromised patients there may be other routes of infection. However, since these represent minimal risk, the HTM does not deal with these aspects.

Prevention

3.18 It has been suggested that the following "chain of causation" must exist for legionellosis to be acquired:

a. an environmental reservoir;

b. opportunity for multiplication;

c. a mechanism for dissemination;

d. virulence to the human host;

e. inoculation of an infectious dose;

f. host susceptibility.

(See figure 1, Chain of causation.)

Scotland: NHS EPM(92)3 and SHPN2

3.19 Employing this hypothesis, the key preventative measures that may be applied are those which break the chain of causation. Strict procedures for water supply hygiene and disinfection are essential and particular attention should be paid to outlets.

3.20 Simple precautions to achieve this objective are:

a. removing all taps and outlets and associated pipework which are not needed, due to disuse or under-use;

Health Guidance Note: '"Safe" hot water and surface temperatures'

b. ensuring that the hot water from the calorifier is at or above 60°C and that it does not fall below 50°C in the circulation pipework;

c. keeping the length of pipework carrying blended water at 25– 45°C to the minimum (never more than 2 m);

d. reducing the length of dead-legs or spurs from the main hot water circulation system to the minimum (maximum 5 m);

e. avoiding water stagnation;

f. introducing an appropriate level of maintenance and ensuring correct and safe operation;

g. maintaining the cleanliness of water systems;

h. using adequate water treatment in wet cooling towers;

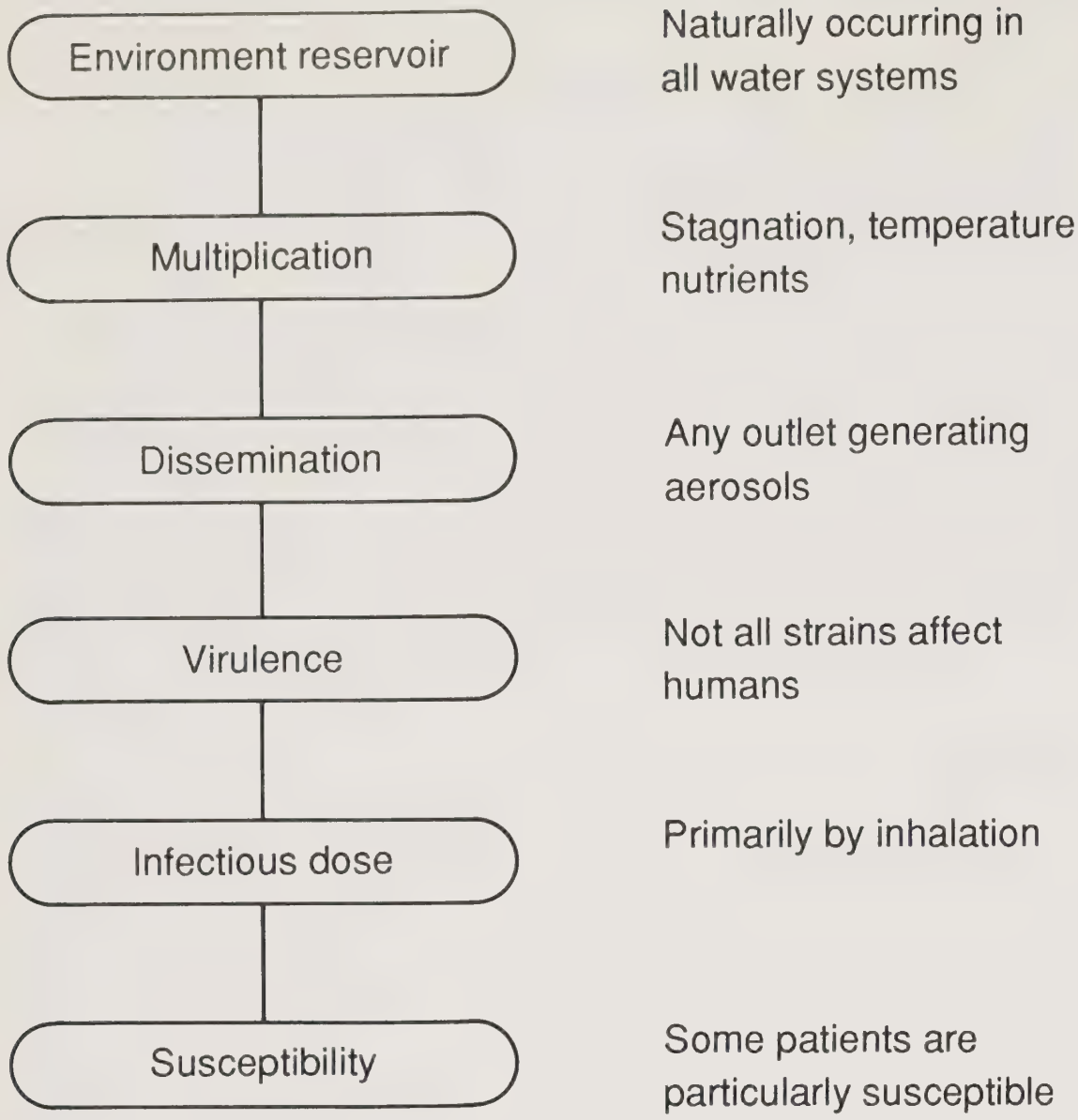

Figure 1: Chain of causation.

j. keeping storage cisterns clean and sealed from extraneous matter and insulating where necessary to maintain temperatures below 20°C;

k. reducing the amount of water stored (24 hours maximum).

3.21 Where systems are known to be of uncertain quality or where consistent problems have been identified, a regimen of additional water treatment systems may be appropriate.

Monitoring and record-keeping

3.22 Based on this guidance and the results of the risk assessment, a written operational plan should be devised. This should clearly identify who has overall accountability for the premises, and who is responsible for devising and carrying out the procedures. The record should include the systems, plant and equipment which pose a potential threat, and a detailed schedule of the preventative maintenance procedures. Finally, provision should be made in the plan for evaluation of the efficacy of the measures.

Water supply and distribution

3.23 It is exceptional for a water supply, either public or private, to be entirely free from aquatic organisms, and consequently it is important that appropriate measures are taken to guard against conditions that may encourage microbial multiplication. Legionellae, like other opportunist pathogens including *Aeromonas hydrophila and Pseudomonas aeruginosa,* are common in the environment and as such can seed treated water systems during construction.

3.24 Micro-organisms can also be introduced during refurbishment, repair, alteration or during routine inspection and sampling.

3.25 Hospital sites are generally large and often contain complex storage reservoirs and distribution systems similar to those operated by the water companies. The water companies or a specialist consultant can assist with the design, specification, tendering and commissioning of such water systems.

3.26 Wherever possible, publicly supplied mains water should not be mixed with private supplies. Each should be separately identified. Where mixing does occur it must be protected by a Type A air gap.

Water treatment regimen

Scotland: SHTN 2 (WRc, byelaws scheme not in itself sufficient. For new materials CCM committee, or WRc Medmenham (J Fawells Dept) approval on toxicity levels is required)

3.27 The regimen of water treatment chosen should be agreed by the infection control doctor (legionellae) and the nominated person (legionellae). The regimen should be of proven efficacy, and substances and products to be used in contact with potable water supplies must be listed in the current edition of the Water Byelaws Scheme's (WBS) Water Fittings and Materials Directory (WFMD).

Northern Ireland: Equivalent provisions are proposed for Northern Ireland (Oct 93)

Scotland: The Water Supply (Water Quality) Scotland Regulations 1990 with amendments

3.28 Chemical conditioning systems which are used in conjunction with potable water systems should be selected very carefully. Addition of any substance must not cause a breach of any requirement in the Water Supply (Water Quality) Regulations 1989 (SI 1989 No 1147), and any system for introducing a substance must be listed in the current edition of the WFMD.

3.29 Consideration should be given to whether or not the process kills only the organisms flowing through the equipment (leaving no residual disinfecting agent in the water) or whether agents are released into the water circuits.

3.30 Further care should be taken to ensure that adequate filtration and/or reverse osmosis is used to provide a pure water supply free of contaminants for water serving clinical processes, for example dialysis equipment.

Air-conditioning

3.31 Air-conditioning and ventilation systems have been shown to provide a route for distributing contaminated air throughout a building. Particular attention should be paid to the humidification process. Ductwork should be examined for evidence of "ponding", that is, places where water has collected.

Design and build contracts

3.32 An outbreak of legionnaires' disease has been associated with healthcare premises built under the "design and build" type of contract, under which the client retains no clerk of works on-site and there is no "commissioning" period on completion of the work. It is essential to ensure that, immediately before occupation, the measures outlined in this HTM have been taken for disinfection and maintenance of temperatures. A nominated person (legionellae) should be appointed immediately before handover. (Adequate documentation, including "as-fitted" drawings, should be available at the time of handover.)

Scotland: Refer to SHTN No 1, PCD

4.0 Epidemiology

General

4.1 Although legionnaires' disease was first recognised in July 1976, when an outbreak occurred among delegates attending an American Legion Convention in Philadelphia, the cause of the outbreak was not identified until January 1977 when the Center for Disease Control, Atlanta reported the isolation of the aetiological agent which they named *Legionella pneumophila.* Diagnostic tests were developed which revealed earlier outbreaks of the disease and sporadic cases dating back to the 1940s. Thus the infection was not new, but had escaped recognition.

4.2 Legionnaires' disease is an illness characterised mainly by pneumophila. Typically it begins quite abruptly with high fever, chills, headaches and muscle pain. A dry cough soon develops, and most patients suffer difficulty with breathing. About one-third of patients also develop diarrhoea or vomiting and about half become confused or delirious. The case fatality rate is similar to that for most other types of pneumonia.

4.3 *L. pneumophila* can also cause a short febrile (feverish) illness without pneumonia known as Pontiac fever. Since *L. pneumophila* was originally isolated, several other species of legionella capable of causing pneumonia have been described in the UK and elsewhere. The 1988 outbreak of non-pneumonic legionellosis at Lochgoilhead in Scotland, now referred to as Lochgoilhead fever, was attributed to the species *L. micdadei*. Legionellosis is the generic term used to cover legionnaires' disease, Pontiac fever and Lochgoilhead fever.

4.4 To date, at least 37 different species of legionella are recognised. The species most commonly associated with disease outbreaks is *L. pneumophila.* Fourteen different serogroups of *L. pneumophila* have been described, *L. pneumophila* serogroup 1 being most commonly associated with cases of legionnaires' disease in the UK.

4.5 There are various sources of the organism and various routes of transmission to humans. Domestic hot water services in large buildings have been shown to be the most common source, but evaporative cooling towers serving the air-conditioning plant in these types of establishment have also been implicated. A poorly maintained whirlpool spa has also been shown to be a source, as have individual wall-mounted humidifiers and nebulisers using tap water.

4.6 In all these instances, the infection is considered to have been acquired by inhalation of small water droplets carrying the bacteria. Aerosols containing such droplets may be generated by running taps or showers and during the normal operation of cooling towers and evaporative condensers. Survival of the bacterium in an aerosol is enhanced if the ambient relative humidity is greater than 65% and if it is sheltered from direct sunlight. Viable bacteria contained within aerosols may travel great distances.

4.7 The incubation period (the time between exposure to the organism and development of first symptoms) may range from 2 to 10 days. There is no record of person-to-person spread of infection. The bacterium is not highly virulent, but it may infect individuals who are specially susceptible. In most

outbreaks fewer than 5% of people exposed to the source of infection have contracted legionnaires' disease, although in some hospital units such as renal and oncology wards, greater attack rates have been reported.

Risk of infection

4.8 The principal route of infection is through inhalation of the bacteria into the lungs. The risk increases with increasing numbers of inhaled bacteria. Other infection routes may include ingestion and external wounds.

Source of the bacteria

4.9 The bacterium is ubiquitous, surviving and multiplying in water. It is widespread in natural fresh water including rivers, lakes, streams and ponds and may also be found in wet soil. Airborne dispersal may occur when water droplets are created. There is a strong likelihood of very low concentrations of the bacteria existing in all open water systems including those of building services. There is also a risk where earthworks are taking place near to open windows or intakes to air-conditioning/ventilation systems.

4.10 The risk is related to the number and types of legionellae in the water at the point of use.

Aerosol generation

4.11 Contaminated water presents a risk when it is dispersed into the air as an aerosol. This risk increases with reduced droplet size for two reasons. First, the smaller the droplet, the longer it remains airborne. Second, small droplets (5 microns diameter or less) penetrate deeply into the lung and cannot easily be expelled. However, larger droplets can evaporate and become smaller ones, still containing the initial number of organisms. Aerosols are produced merely by water streams breaking up after striking a surface or by a bubble bursting on the water surface.

4.12 In both a cooling tower and an evaporative condenser, water is distributed over large areas of wetted surfaces to create intimate surface contact between air and water, increasing the opportunity for the formation of aerosols. Water services are also capable of generating aerosols from the impact of tap water hitting wash-basins, sinks and baths, and from showers.

4.13 In whirlpools and spas the refreshing agitation of the water is achieved by the combination of air jets and pulsating water flow. Splashing of the water and bursting of the air bubbles as they break through the water surface creates an aerosol immediately above the water surface.

4.14 The risk increases with the number of "infected" droplets in the aerosol generated, especially if the size of droplet in the aerosol is within the range 2 to 5 microns in diameter.

Number of inhaled bacteria

4.15 Two factors determine the number of bacteria deeply inhaled:

a. the concentration of bacteria in the air:

(i) this is determined both by the concentration of bacteria in the water and by the amount of contaminated water dispersed into a given air volume. The concentration of live bacteria in the air falls rapidly with distance from the source. Where a cooling tower and the fresh-air inlet to a building are both at roof level, it may be possible for contamination from the tower to reach the air inlet and hence enter the building;

(ii) the quantity entering will depend primarily on the separation distance between the tower and the fresh-air inlet. Increasing this distance of separation and locating the air inlet upwind (prevailing wind) of the tower help to reduce the likelihood of water droplets containing legionellae from entering the building;

b. the duration of exposure to the contaminated air:

(i) exposure in a shower is usually limited to a few minutes, while exposure in a spa is usually longer. Exposure to airborne legionellae distributed in a building from a contaminated cooling water system may take place whenever the tower is operating, which may be most of the day during the summer;

(ii) the risk increases with the number of legionellae in the air and with the respiratory rate of the individual, and the length of time the person is exposed. The chances of legionella infections occurring increase with the number and susceptibility of people exposed.

Susceptibility of individuals

4.16 While previously healthy people may develop legionnaires' disease, there are a number of factors which increase susceptibility:

- increasing age, particularly above 50 years (children are rarely infected);
- sex: males are three times more likely to be infected than females;
- existing respiratory disease which makes the lungs more vulnerable to infection;
- illnesses, such as cancer, diabetes, kidney disease or alcoholism, which weaken the natural defences;
- smoking, particularly heavy cigarette smoking, because of the probability of impaired lung function;
- patients on renal dialysis, or on immuno-suppressant drugs which inhibit the body's natural defences against infection.

5.0 Ecology

5.1 The following conditions have been found to influence the colonisation and growth rate of legionella:

a. water temperatures in the range 20 to 45°C favour growth. It is uncommon to find proliferation below 20°C, and the organisms do not survive long above 60°C. The optimum laboratory temperature for the growth of the organism is 37°C, that is, body temperature. Organisms may, however, remain dormant in cool water, multiplying only when the temperature reaches a suitable level;

The death curve is logarithmic with time for a given temperature

b. the presence of sediment, sludge, scale and organic material provides a good nutrient source for legionellae. Evidence suggests that the presence of iron oxide (rust) also favours the growth of the organism;

c. legionellae have been shown to colonise certain types of water fitting, pipework and material used in the construction of water systems. The presence of such materials and of large quantities of sediment may provide nutrients for legionellae and can make eradication difficult;

d. other commonly encountered organisms in water systems such as algae, amoebae and other bacteria may serve as an additional nutrient source for legionellae. Algal slime may provide a stable habitat for multiplication and survival. Legionellae have been shown to proliferate rapidly in association with some water-borne amoebae;

e. exposure to direct sunlight may inhibit the growth of legionellae while stimulating the growth of algae and the formation of slimes;

f. biofilms are thought to play an important role in harbouring and providing favourable conditions in which legionellae can grow;

A biofilm is a slime which develops on surfaces in contact with water

g. stagnant water encourages colonisation.

Appendix – Management checklist

A logbook recording the action taken on this checklist is recommended

Legionellosis risk assessment

1. Appoint infection control doctor (legionella) and nominated person (legionella).

Existing drawings should be checked for accuracy

2. Produce record of drawings and schematics for all water systems. The drawings/schematics should show:

a. layout and arrangement of all calorifiers and pumps;

b. layout and arrangement of all cisterns, humidifiers and cooling towers;

c. all other water systems, such as hydrotherapy pools, which may present a legionellosis hazard;

d. dead-legs and blind ends, with lengths and diameter indicated;

e. operation and check points for cross-referencing with operational instructions and temperature records.

Scotland: Refer to SHTN No 1 PCD

There should also be adequate documentation which details the engineering design intent and maintenance and operation procedures.

3. Identify work needed to be carried out for compliance with this HTM and HS(G)70. This will require:

a. tracing all water pipework;

b. measuring the time taken to achieve recommended temperatures at hot and cold water outlets;

c. measuring temperatures at all cisterns, calorifiers, humidifiers and cooling towers, and at other strategic points to check compliance;

d. checking layout and arrangement of cisterns, calorifiers, pumps, humidifiers, cooling towers and other water systems which may present a legionellosis hazard;

e. identifying little-used outlets and associated pipework which could be removed.

4. Develop schemes for risk minimisation and control in order of priority, having considered cost, risk and difficulty.

5. List all buildings in priority order of non-compliance and potential risk.

6. Devise an agreed management programme for the minimisation of risks identified in (5) above. This should be an action plan identifying resources and time-scales.

7. Manage the programme described in (6) above and identify compliance failures for remedial action.

8. Review the programme at yearly intervals to record progress in implementing the programme. All changes to the water systems and functional content should be recorded and evaluated.

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2021 Electrical safety code for high voltage systems, 1993.
22 Piped medical gases, medical compressed air and medical vacuum installations*†
22 Supp. Permit to work system: for piped medical gases etc†
23 Access and accommodation for engineering services†
24 –
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26 Commissioning of oil, gas and dual fired boilers: with notes on design, operation and maintenance†
27 Cold water supply storage and mains distribution* [Revised version will deal with water storage and distribution], 1978.
28 to 39 –
41 to 53 –

Component Data Base (HTMs 54 to 70)

54.1 User manual, 1993.
55 Windows, 1989.
56 Partitions, 1989.
57 Internal glazing, 1989.
58 Internal doorsets, 1989.
59 Ironmongery, 1989.
60 Ceilings, 1989.
61 Flooring, 1989.
62 Demountable storage systems, 1989.
63 Fitted storage systems, 1989.
64 Sanitary assemblies, 1989.
65 Signs†
66 Cubicle curtain track, 1989.
67 Laboratory fitting-out system, 1993.
68 Ducts and panel assemblies, 1993.
69 Protection, 1993.
70 Fixings, 1993.
71 to 80 –

Firecode

81 Firecode: fire precautions in new hospitals, 1987.
81 Supp 1, 1993.
82 Firecode: alarm and detection systems, 1989.
83 Fire safety in health care premises: general fire precautions*†
85 [Revision to Home Office draft guidance in preparation]
86 Firecode: assessing fire risks in existing hospital wards,1987.
87 Firecode: textiles and furniture, 1993.
88 Fire safety in health care premises: guide to fire precautions in NHS housing in the community for mentally handicapped/ill people, 1986.

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